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## The Silicate Emission Feature in Comet Mueller 1993a and the Origin of Annealed Grains

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Since comets formed in cold regions of the solar nebula, unaltered interstellar silicate grains should have survived in comets. Yet, spectra of cometary dust differ from spectra of interstellar dust. A distinct peak at 11.2  $\mu\text{m}$ , attributed to crystalline olivine, was detected in P/Halley and long period comets Bradfield 1987 XXIX and Levy 1990 XX, but this signature of annealed grains is absent in spectra of interstellar dust.

We have obtained 8- 13  $\mu\text{m}$  spectra of new comet Mueller 1993a at R=2 AU with the Aerospace Corp. broadband array spectrograph at the NASA IRTF. The spectra clearly reveal the 11.2  $\mu\text{m}$  peak for the first time in a new comet. This result implies that crystalline olivine must have been widespread in the solar nebula material from which the comets formed, although it constitutes only a fraction of the silicate material.

Where did these annealed grains originate? The required temperature for formation of crystalline grains in the solar nebula was attained at small heliocentric distance,  $R \leq 1$  AU. This would imply that extensive radial mixing occurred between the inner and outer solar nebula, in contrast to some current nebula models. Either radial mixing was more extensive than presently modeled or the olivine grains had a presolar origin. If presolar, then the lack of an olivine signature in the spectra of the interstellar medium and young stellar objects is puzzling.

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